AMAUROSIS.

CLINICAL LECTURES

ON SOME OF THE

Principal Diseases of the Eye,

DELIVERED AT THE

NEW-YORK MEDICAL COLLEGE,

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BY ISIDOR GLÜCK, M. D.

Cor. Fellow Med. Society of London.

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[From the American Medical Monthly, January, 1855.]

Amaurosis, Amblyopia, Subjective and Objective Light, Myopia, Presbyopia, etc.

GENTLEMEN! The natural range of the eye almost exceeds belief. The distance of the smallest stars distinctly visible to the naked eye is known to be such, that light, which travels at the rate of nearly 200,000 miles per second, occupies one hundred and twenty years in coming from them to the earth.* The unaided eye, therefore, gives us the survey of a sphere around us of that scarcely conceivable radius. But this power of vision may be materially injured by seemingly small morbid changes, scarcely appreciable; or even destroyed by an apparently unaltered structure of the parts constituting the organ of sight, or may be impeded or annihilated in consequence of morbid alterations of the functions of the various organs, reacting by means of the vascular or nervous systems on the eye itself.

If we reflect that the majority of the different diseases of the eye (with the exception of traumatic diseases produced by mechanical or chemical causes) are attributable to general consti-

* Arago.

tutional causes, we shall scarcely be surprised that amaurosis is eminently so. Although the diseases of the eye may originate with and be excited by epidemic or endemic influences, or by such as in the healthy individual should be followed by no morbid reaction of a serious nature, the peculiar diathesis or constitution may give rise to a further development of the morbid organico-chemical process, and thus tend to stamp the disease with a certain character mainly dependent upon the individuality, and not proportionate to the influence encouraging or producing a morbid alteration of the parts constituting the eye, or effecting a morbid alteration of its function. Thus the various exudations on the retina and choroid coat producing amaurosis may, regarding their quality and quantity, depend upon a morbid constitution.

The anæsthesia as well as the hyperæsthesia of the nervous texture of the eye, shows itself under the most different forms. The former according to the cause, which may be either a central or a peripheral one.

The central causes may produce amaurosis of an intermittent or of a continued type; the nature of the causes producing similar affections is not yet entirely known, and satisfactory elucidation is still wanted. Temporary amblyopia and amaurosis, met with after copious loss of blood and congestions, for instance in fevers before the crisis, or in intermittent fever, or in nervous and hysterical subjects, indicate an affection of the brain, but do not materially influence a favorable prognosis. But an amblyopia resulting from an exhausting disease, as phthisis, in which when near the end the patient craves for light in the bright day, affects the prognosis differently. These are mostly fatal symptoms.

Amauroses which develop themselves in the shortest time, without being the result of a morbid change in the eye itself, are more or less in connection with organic destructions of those parts of the brain and of its membranes which are connected with the organ of sight. Similar degenerations are little apparent in their first development, but they are known in the progress of the disease through various other morbid alterations of the function exerted by the brain.

While the sight of the left eye is entirely gone in the woman

you have before you, she retains some vision in the right eye. You meet, therefore, in this instance of respective amaurosis and amblyopia a variety of phenomena worthy of closer consideration.

To avoid repetitions, I will confine myself to appearances hitherto but briefly mentioned. The exertion of adjusting the sight will be apparent to you by the various movements the woman performs with her head in order to distinguish an object held somewhat remote. By the transparency of the dioptric media we may judge the cause to be an incompetency of perceiving from want of an adjusting power.

Cramer asserts and proves by experiments that in the normal state of the eye, the form of the anterior surface of the lens is changed by the adjustment of sight. He allows the light to fall on one side, and observes as usual from the other side the three images reflected by the cornea, the anterior and the posterior surface of the lens. By his ophthalmoscope, and far better by that of Donders, connected with his speculum, it is not only possible to observe the change of the image reflected from the anterior surface of the lens and its relative position, but it enables one to calculate correctly by measurement, how much the *curvature* of the anterior part of the lens is increased.

The observed eye is adjusted to the crosspoint of two threads extended very near, and one looks at the images (projected on a surface which is vertical to the axis of vision of the observer's eye) reflected from the anterior and posterior surface of the lens, which by this adjustment appear closely situated, almost in immediate nearness. If the observed eye is now directed to look in the same direction beyond the threads to a remote distance, the image formed by the anterior surface of the lens removes backwards from the corneal image, and is situated almost in the middle between both images. By this movement the image formed by the anterior surface of the lens becomes larger and duller. It is known that a more convex mirror forms a smaller image, and that therefore, the change of form and brightness of the image during accommodation to near objects, proves a stronger curvature of the anterior part of the lens. According to Cramer, the greater curvature of the anterior surface of the lens is caused by the iris. Winslow noticed that

the iris is capable of exerting a pressure on the lens, in consequence of which the lens must recede without recognizing herein the cause of a stronger curvature of the exposed part of the lens, which corresponds to the pupil. Stellwag von Carion observes that a similar pressure on the lens must be the necessary consequence of a synchronic effect of the circular and radial fibres of the iris, because through it the iris thus curved anteriorly, receives the tendency to extend its surface.

Cramer asserts that during contraction of the circular fibres, the radial fibres extend as if included between two fixed points, the origin and the pupillary margin; consequently their contraction must exert a pressure on the parts situated in their concavity. When the pupil is much dilated, only the ciliary processes and the zonula Zinnii are pressed upon. When the same is contracted, the margin of the lens is exposed to pressure, whereas by the much contracted pupil the greater part of the surface of the lens is pressed upon. As the lens is incapable of receding, the pressure must be followed by a greater convexity of that part of the lens that corresponds to the pupil. The softness of the cortical layer of the lens favors the change of form.* The space for the aqueous humor remains the same, since the space lost in the centre of the anterior chamber, through the convexity of the lens, is regained by the expansion of the iris in the periphery of the chamber. As soon as the pressure ceases, the original form of the lens is regained by the elasticity of its capsule. The force with which the iris presses upon the parts situated in its concavity depends upon the length of the curvature which the iris forms in its extension, consequently upon the greater or smaller dimension of the pupil; and upon the degree of tonicity or contraction in which the longitudinal and circular muscular fibres exist. The manner in which a greater curvature is effected, by contraction of the pupil, is the following. It appears that two points have to be considered,

1. The smaller the surface of the lenticular part corresponding to the pupil, the shorter will be *cæteris paribus*, its radius of curvature.

2. The smaller the pupil, the longer are the radial fibres of

* Huschke, Forbes.

the iris, and the less the radial fibres are shortened by their contraction, the greater their power.* For this reason, also, the eye may be adjusted to fix upon a near point by a more intense light, and convergent axes of vision, by which means the effect of the orbicular fibres is increased, and the pupil becomes contracted. No doubt it is attributable to this circumstance, that contraction of the pupil, produced by suddenly impinging light, adjusts the eye *for a moment* for a near point, whereas dilatation of the pupil, as caused by the closure of one eye, adjusts it for a more remote distance.

The state of accommodation may, according to the tonicity, vary very much, even by an equal dilatation of the pupil, as the effect of the orbicular or radial fibres may be a different one, on equal dilatation of the pupil.

Cramer asserts that the greater curvature of the anterior surface of the lens, effected during accommodation for near objects, depends upon contractile elements contained in the eye itself. He brings, in support of this view, the phenomena of the effect of belladonna. By its application, the power of accommodating for nearness is diminished. By a much dilated pupil, vision is less defined at any distance, which depends upon the less complete form of the marginal parts of the lens. Volk mann states that the effects of belladonna consist—

I. In diminishing the power of adjusting the eye to nearness.

II. In diminishing the power of adjusting the eye to remote distances.

III. In increasing the passive sight, *i. e.*, by which, without previous exertion, objects are seen distinctly.

For the sake of ascertaining whether the diminished accommodation for nearness does not depend upon the dilatation of the pupil, (admitting diffused rays) Donders made optometric experiments, in which the rays could pass through only the central part of the lens, and convinced himself that the power of accommodating for nearness was really diminished.†

* Schwann.

† After the use of belladonna objects appear diminished, in some instances micropic, as Donders first observed. Warlomont observed a similar case in a man of about forty, who for some time suffered from the appearance of motes. For the sake of an examination of the eyes, a belladonna solution was dropped in the

According to Cramer, there is no posterior chamber, the iris rests upon the lens, on the ciliary processes, and the zonula Zinnii and presents always a slight convexity, which it derives from the lens; one organ depends upon the assistance of the other. The iris* could not expand and contract over the capsule without being somewhat convex, and must rest on a solid body on account of its longitudinal and circular fibres. Stellwag von Carion assumes that some fluid exists in the immediate vicinity of the lens, as if included in a channel, which remained between the iris and the zonula Zinnii. It can be proved that no posterior chamber exists, if recent eyes are frozen, and then in a sufficiently frozen state, are cut through in the axis of vision.

Arlt, however, states that between the anterior capsule, and the pupillary part of the iris, only so much aqueous humor always exists, as must enter between two surfaces according to

eyes. After a quiet night the man passed, he was not a little surprised to find himself as if in another world; he took up a journal laid on his night table and found the letters microscopically small; he rung for the maid servant, when she entered she appeared to him like a little child ten years of age; he stretched his hand for his clothes and they appeared to him like childrens' clothes. Entering the dining-room his wife and children appeared to him like dwarfs and dolls. On his way to his physician, the horses appeared to him like dogs, and the dogs like rats; in short he felt as if transported amongst Gulliver's Liliputians. The examination of the eyes showed but a dilated pupil. Cold lotions reduced the state of the eyes to a normal condition, with the exception of the motes.

* *The Muscular Fibres in the Bird's Eye.* Besides the transverse striped circular fibres, first closely examined by Krohn, Cramer assumes radial organic muscular fibres, which are under the influence of the sympathetic nerve. But he does not seem to have seen them, at least not to have isolated them, and infers merely their existence from the enlargement of the iris, observed during pricking of the regio cilio spinalis of the spinal marrow. That this is no proof of its existence will be apparent by the following. Another muscle, also constituted out of transverse striped fasciculi appears in the eye, the analogon of the tensor choroideæ and of a peculiar nature, only according the form of the bird's eye. This muscle had an unlucky fate. Having been discovered by Crampton, it received his name (Musc. Cramptonianus). Its muscular nature was put beyond doubt by Krohn. Brücke subsequently made two muscles out of it, one of which should be situated between the membrana descemetii and the osseous ring, and the other between the osseous ring and the choroid coat—the first alone should be the musculus Cramptonianus, the other should as analogon of the newly discovered tensor choroides have that name. Cramer, however, asserts that he found this other muscle after a careful examination as Crampton described it, but he asserts at the same time,

the laws of attraction. This mediate apposition of the iris to the capsule secures to the pupillary part of the iris a steady position during the different sudden movements of the ball. If more aqueous humor should exist, the iris would constantly float in it backwards and forwards. In fact this movement is seen in the ciliary portion of the periphery of the iris, as often as it is looked at steadily after a sudden movement of the balls because a larger quantity of the aqueous humor exists behind the periphery of the iris. After shrinking or resorption of the lens, or if the iris is no longer in firm connection with the ciliary body (through the zonula Zinni), it is seen floating about and even an extension of the iris through its circular fibres is not able to secure to it a steady position. It must move according to the laws of gravity, like any other moveable body suspended in a fluid. However, whether you assume a locomotion of the lens, or a curvature in the anterior surface of the lens

that the musculus Crampt. originates on that part of the choroid coat on the interior of which the ciliary processes exist, and that it *affixes* to the anterior inner surface of the osseous ring and the membrana descemetii, and not as Crampton and Brücke assert, that it originates in the interior surface of the ring, and connects with the membrana descemetii. In birds, the musc. Crampt. should be like the tensor choroideæ in man so intimately connected with the inner wall of the canalis Schlemmii, that this latter remains hanging to it when the muscle is separated, to which circumstance, Crampton is said to have drawn attention. Crampton was aware of its connexion with the choroidea, as it appears by his words. It is inconceivable how Cramer could, after his description, have assumed with Brücke, besides the Cramptonian muscle yet another, as Cramer's description of the Cramptonian muscle includes the two muscles of Brücke.

The existing confusion induced Donders to make investigations himself. It appears to him beyond doubt, that only one muscle exists, deserving the name of Crampton's muscle, (having used for investigation eyes of Calcutta-chickens, and those of domestic chickens, geese, ducks and pigeons). It originates like a neat half-feathered small muscle on the outer wall of the canalis Schlemmii, in which wall the membrana descemetii scarcely participates, and further from the outside of a fibrous-like bundle, which isolates itself from the mentioned wall, in order to proceed backwards at a considerable distance, following the curvature of the osseous ring. The anterior fibres run outwards and backwards and fix themselves at the fibrous-like texture of the sclerotica, which lines inwardly the osseous ring; the more backwards of the fibrous-like cord they begin, the more they recede in their course, so much so, that the last in following the curvature of the sclerotica, fix themselves to the outside of the choroid-coat, on that part where the osseous ring made room in the sclerotica to a layer of true cartilage, commonly described as horny.

Bowman's ciliary muscle is at any rate participating in producing the accommodation of sight. The appearance of flashes in the eye deprived of vision, which the patient complains of, depends entirely upon a subjective process.

Subjective appearances of Light and Color.

The different rays of light, the white as well as the colored impress our eyes according to the variety of their nature differently, and produce by it certain conditions which cause in our mind the perception of light and color. Those different rays however, are by themselves neither white nor colored, but receive only this property by our perception through the various states produced in us, which we designate with the name of white, orange, &c.

Similar conditions of our nervous apparatus of the organ of vision may be produced by processes which take place in our organism, caused by pressure for instance, electric shocks, and affection of the brain, which exert an influence on the corresponding nerves, and are produced by their own activity. The conditions thus produced are called the subjective appearances of light and color. They are exclusively products of the organic activity of the organ of sight and not qualities of the outer world.

Many subjective phenomena prove that the state of the nervous apparatus of the eye, presents itself to the mind as the appearance of light and color, and that the external light is no longer sufficient to produce them, if the subjective conditions are wanting. Thus :

If the retina is paralysed no light is capable of producing the sensation of light and color ; if the same is but torpid an intense light is necessary to produce only a moderate perception of light. A person, therefore, whose retina is in a torpid condition sees well only in the *bright noon*. (Hemeralopia).

If we leave a very bright room for a darker one, the latter appears to us perfectly dark, because its light is not sufficiently strong to impress the retina and produce an activity in it, as it is benumbed by the intense degree of light until the retina has recovered. The wise arrangement of the frequent movements of

the eyelids, to prevent a continual exhaustion of the nervous power will be apparent, and is necessarily obvious.

The intensity of light, be it from a glaring snowfield, or any other strongly reflecting surface, may exhaust the power of the nervous apparatus, and thus produce (snow blindness) Nyctalopia. Some forms of it are so severe, that even the ordinary daylight cannot be borne.

If you look long and continually on a light, bright field, the power of vision diminishes and disappears ultimately, and the field of vision appears cloudy, and subsequently bright. and again turns dark in consequence of a passing or temporary exhaustion of the retina, an appearance which occurs in persons suffering from debility in consequence of general exhaustion.

If we remain for a long time in a dark room, and change it suddenly for a very bright one, we are dazzled by the light although it may not exceed the intensity of the ordinary light *i. e.*, the retina debilitated by the continued privation of the excitement of light, looses its power of activity, and thus becomes overexcited by the respectively too intense light and, under very favorable circumstances, even paralized.

In May, 1849, at Watz, in Hungary, a man 37 years of age presented himself to me for medical examination, in presence of the other members of the military commission, in order to be enlisted in the Hungarian army. He left the prison but a few weeks previous, where he was detained for a period of eleven years. I could conscientiously support our commission in its intended refusal of his entry into the army, on account of his previous misconduct, by proving his physical inability of serving in this way. I desired him to look through the window, where a strong light came in ; after a minute I turned him round and asked for the number of fingers I held before his eyes ; he not only could not tell the number, and not perceive the hand which I made him grasp with his own, but he was not even after ten minutes capable of finding his way to the door. He retired, or rather was led away, satisfied with the melancholy conviction of his incompetency. I was led to this trial by observing his intolerance of light.

The contrasting change of light and darkness is very trying for the organ of vision, and debilitates it considerably. For this

reason lamps covered with non-transparent shades are injurious to sight, as merely the table and some parts of the room are illuminated well, whereas the other parts of the room are dark.

Much more appropriate, and of more advantage, is a shade of light blue color, on a very intense light, which mitigates the light by changing its quality, with less diminution of its quantity.

A similar injurious effect is produced in weak eyes, if only one light is used in a large room, the contrast being apparent by the insufficiency of such an illumination.

The activity in the retina is often produced by previous intense excitement, and its subsequent effect is displayed in an after-tone of an intense excitement. They are, for instance, the strongest after an over-exertion of the eyes on a previous day, by cerebral congestion, after the use of narcotics, as belladonna, hyoscyamus, after inflammations of the eye, choroiditis, retinitis, &c. The impressibility to external light may be almost, or even entirely abolished, and the mentioned appearances may still continue and form the so-called chrupsy, (flashes of light,) and chromopsy, (appearance of color,) which are most complained of in the erethic and congestive form of amaurosis.

The sensation of external light does not produce the representation of a certain condition of our peripheric organ of sight, but causes the representation of something *objective*, implying the existence of an excitement situated externally, and not in us. If a second luminous point appears before the eye, corresponding entirely in quality to the first one, we have no longer, as before, a single sensation of light, the intensity of which should be merely the double of the first; but we receive two isolated impressions, existing contemporaneously and with another. This property belongs exclusively to the organ of sight.

If two sounds, similar in quality, of equal pitch and vibration, touch the ear, we do not distinguish two single isolated impressions, but the intensity of the perceived tone is augmented proportionately to the force of the second impression. Similar are the impressions of the organs of taste and smell.

The organ of sight possesses unities of sensation. Several similar impressions received synchronously, do not sum up to a

resultant, but remain isolated and separate to the perception. A tone is to us something objective, and we hear the different tones of an accord synchronically; we may hear single tones out of an orchestra, but there is no relation in the synchronic juxta-position, if we abstract from the intrinsic relations of its value, we can say only that they exist contemporaneously with another.

In the unity of sensation, produced in the organ of sight, there are *local, spacious* relations. We receive the impressions as something objective, localized in space. This localization of each unity of sensation consists in the representation of its three several relations to those of others. We call it the *value* in three dimensions.

All sensations of light, synchronically existing in the representation, do not form a mere contemporaneous juxta-position, but they produce the representation of a local juxta-position in a certain order, each unity of sensation having a certain value in the dimensions of length, breadth, and depth.

The perception of light depends upon the influence of waves of ether on the retina; the intensity of the perception corresponds to the intensity of vibration; the difference of the length of the waves causes the different qualities of light. The perception of unity depends upon the arrangement and relative position of the dioptric media. One and the same impression of light may have many different values, in length, breadth, and depth, and those three values are qualities of the impression of light.

All relations of size and form, to the representation of which we are forced by impressions of sight, are but *space-value* of unities of perception. We do not perceive absolute sizes, but in the perceived relation of sizes we become conscious of spacious relations of points, unities of perception of our peripheric organ of sight.

The last causal moment of every psychic state of excitation, the influence of an external excitement, we may consider as a mutual re-action of two bodies. The result of each mutual re-action is not dependent on one body alone, but always on both. If we know that the result of two re-actions following each other be different in two bodies, although the influence of

one of both objects be similar in both instances, we may infer that in both instances the other body participated, in a different manner, in the mutual re-action. The simplest perception of light, the final result of a mutual re-action between a luminous point and the peripheric organ of sight, may have the most different values of space, without its other properties undergoing a modification. The luminous point may exert its influence always in the same way, as long as it appears in the field of vision; the representation caused by the perception being different in the value of space, in comparison with the supposed real value of space, we infer that the second body, *i. e.*, the peripheric part, which came in mutual re-action, exerted its influence, or behaved in a different way, and by doing so caused the questionable diversities of the otherwise similar psychic state of excitement.

In order that objects should be seen single, it is necessary htat the axes of vision should cut each other in a point of an object situated at a distance commensurate to the refractive media and the power of accommodation. According to John Muller, only such points of an object can be seen contemporaneously which lay in the periphery of a circle described by the fixed point (of the object) and the centre of both lenses. This circle Muller called Horopter. The protuberantia sclerotica lis described by Ammon* is a distinctly visible enlargement of the sclerotica, and later of the retina,† of the fœtal eye, until the eighth month, and exists at the external posterior circumference exterior to the macula lutea—this protuberantia sclerotica lis, considering a horizontal middle section, seems to cause a difference in the curvature of the external and internal half of the retina, so much so, that the external half seems to describe a wider circle than the inner one.

Although this protuberance disappears in the subsequent development, its existence in the previous stages of development could easily awaken the supposition, that even in the fully developed state of the retina there may exist a difference in the curvature of its outer and inner half. Such a difference needs

* Zeitschrift fur Ophthalmologie, II. p. 503.

† The retina affixes to the sclerotica only by degrees.

only to be very small. The small axis of the ellipsis formed by the retina needs to be only very little exterior to the centre of the macula lutea in order to be already of a considerable influence on the form of the horopter, as the distances of the images of two points on the retina are extremely small, compared even with the smallest distance at which objects are situated before the eye. Baum found his supposition of the form of the horopter verified by experiments.*

Meissner designates with the name of horopter that part of the space in which lay those points which, with the fixed point, are seen contemporaneously simple; and admitting for the sake of argument, what generally is not true, that the horopter has no extension in the third dimension, it is a surface formed and situated somehow in which a changeable fixed point is situated, the nature of which is to be considered. The centre of that part of the space which presents to the observer always to the utmost merely the dimension of length and breadth is the fixed point, and if you imagine that surface in both its dimensions, divided by a horizontal and vertical cut running through the fixed point, the horizontal line of division forms Muller's horopter; and under the supposition that the surface to be investigated be plane or irregularly curved, the perception of the horizontal and vertical line of transitions give sufficient information of the quality of the surface itself.

The child in which the difference of curvature, resulting from the existence of a previous protuberantia scleroticalis, still exists, has a near horopter; it fixes objects, and amuses itself with those situated closely. With more advanced age this difference of curvature becomes gradually equalized in both halves, and at last, perhaps, disappears altogether. In harmony with this process, the middle horopter (Mesoropter) removes farther with the progressing development. The dioptric apparatus of the organ of sight causes with advanced age presbyopy, and with it a remote horopter.

Sichel distinguishes a myopic and presbyopic amblyopia: to understand these forms, it will be necessary to make you ac-

* Brought forward and ably discussed by Dr. George Meissner, in Beitrage zur Physiologie des Sehorgans Leipzig, 1854, that really proves a valuable addition to the Physiology of sight.

quainted with the state of vision called Myopy, and another named Presbyopy.

Myopy.

Near-sightedness is that condition of sight in which small objects appear clear and defined, distant ones, on the contrary, obscure and ill-defined, or not at all. This state of vision is produced by such a physical change or relative position of the refracting media of the eye, by which only rays of light coming from near objects can be united to form an image on the retina, whilst the images of distant objects fall on the vitreous body before the retina, forming on it circles of diffused rays of light. The myops has a near and distant point of distinct vision. Those points are often only very little distant from each other, being sometimes but three to five inches for the near point, and eight to twelve inches for the distant point. The near-sighted person sees small objects more distinctly than the far-sighted one, because they appear to the former under a greater angle of vision when looked at very near, and the same sees small objects in a subdued light clearer than the far-sighted one, because an object when held close to the eyes, sends more rays of light to the eye than if held at some distance. The near-sighted one reads easily, therefore, when the far-sighted one is no longer able to do so; near-sighted ones see objects double or multiplied on account of the several circles of diffused rays which form themselves in consequence of the irregular curvature of the refracting media, and form a single defined image only by a correct accommodation of sight.

Sometimes both eyes of an individual have an unequal refracting power; so much so, that the one eye is comparatively more near-sighted than the other. This condition of the eyes is congenital, or the fault of an unilateral use of the sight during reading, writing, drawing, painting, looking through the eye speculum, microscope, &c.

This kind of myopy occurs frequently in juvenile individuals, and is to be treated as soon as its appearance threatens, by change of occupation, abstinence from reading, writing, chiefly in the subdued or even in the bright artificial light. The accommodation to a distance is very useful, and the best means

of increasing the capacity or range of vision. Individuals at work by the use of magnifying-glasses, as engravers, etc., will derive a benefit by changing them for those of a different focus.

Upon individuals suffering from habitual congestion of the brain, the very injurious habit of smoking will in no instance exert more its obnoxious effect than in this kind of myopy, where besides the congestion it produces, the sight is more or less excited through the cigar and its fumes for an accommodation to nearness.

Ruete assumes three kinds of near-sightedness according to the causes producing them:

The first is occasioned by spasm in the ciliary nervous system by which no doubt a forward motion of the lens takes place; such a near-sightedness is mostly of an intermittent character, and depends probably upon an affection of the sympathetic nerve. The cause of this affection may be situated in the eye itself, or in parts of the nerve remote from the same, and therefore reacting on the ciliary nerves by irradiation.

The second species of myopy depends upon such organic changes of the refracting means of the eye as increase their refracting power. They may be of different nature, increasing the density of the refracting media, or prolonging the diameter of the optic axis.

The third kind of myopy is produced by an improper use of the sight, and develops itself by degrees; chiefly with persons of certain conditions and occupations in which the eyes are strained unilaterally looking at near and small objects, thus neglecting the exercise of seeing and adjusting the eye in and to a distance; as artists, writers, savans, etc. The eye is active by looking through convex as well as through concave glasses, as it accommodates itself to seeing at a distance with the former, and to looking near with the latter. The continued use of convex glasses increases myopy, whereas the protracted use of concave glasses increases presbyopy.

Presbyopy.

Far-sightedness, presbyopy designates the state of vision in which remote objects are clearly seen, whereas the power of

adjusting the sight for near objects is very small, or even wholly wanting. The insufficient refraction of the media causes the image to fall behind the retina. Like the normal eye, the presbyopic one has no distant point; but the near point at which objects can be recognized distinctly is at 15–60 inches, consequently further than the normal eye. The accommodating power is therefore debilitated, paralyzed, although the eye is in other respects healthy. In newly-born children the axes are parallel, as their eyes did not yet learn to fix objects in changeable distances. The equal tendency of all the muscles of the eye, the parallelism of the axes of vision, is a constant one, even during the movements of the eyes in different directions, until the child learns how to subordinate the muscles to his will, and hence objects must appear to children double and indistinct, till they learn by degrees to give to the axes of vision a proper direction, in order to see the objects simple. Children seem to be far-sighted in their first year; their visual axes are parallel, and they seem to look seldom at near objects. In advanced age the power of accommodating for nearness is lost; hence the removal of a book when reading. The occupation with remote and larger objects, as that of hunters, seamen, shepherds, very often causes neglect of accommodating the sight to objects situated near. A constant parallelism of the visual axes produced by an over-weighing of the external muscles, causes a morbid presbyopy. It becomes easier in this state to direct one's sight, and accommodate it to greater distance and objects situated in it, than it is to look at objects closely situated. Myotomy corrects this error by admitting the convergency of the visual axis, and thus facilitates the accommodation for near objects.

Circles of diffused rays of light are formed by imperfect accommodation, when the image falls before or behind the retina, and the diverging rays before or after the union of the rays of light necessary for the formation of an image fall on the retina, thus forming an imperfect, and with dioptric colors, mixed image.